TITLE OF THE INVENTION

LAMELLA OF A HEADBOX OF A PAPER, CARDBOARD OR TISSUE MACHINE

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CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. §119 of German Patent Application No. 101 06 684.8, filed on February 14, 2001, the disclosure of which is expressly incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a lamella of a headbox of a paper, cardboard or tissue machine. At least one fibrous suspension flows through the headbox, which features a machine-width headbox nozzle having an exit opening. The nozzle has a nozzle length formed by an upper nozzle wall and a lower nozzle wall and a lamella mounted therein.

2. Discussion of Background Information

[0003] Such a lamella of a headbox in the form of a multi-layer headbox is known, e.g., from German published patent application DE 44 40 079 A1. The headbox nozzle of the disclosed headbox contains at least one lamella that keeps two neighboring fibrous suspension flows separate from one another until the area of an exit opening. The lamella is embodied in a symmetrical way until the area of the exit opening and features at its lamella end a bilateral slope of, e.g., about 2° to 4°, on its upper and lower sides.

[0004] Furthermore, another such lamella of a headbox is known, e.g., from German published patent application DE 43 29 810 A1. The lamella features grooves in its end area which are preferably provided on the upper and lower side of the lamella in various embodiment types and positions or orientations.

[0005] The known lamella forms and structures feature alone or in combination

with one another the disadvantage that they lead to unstable flow conditions and thus to oscillation tendencies, i.e., the flows do not always run symmetrically, e.g., when a screen is present at the exit opening, and possible lamella structures cannot be optimally flowed against to avoid turbulence. These difficulties result in a deterioration of the stream quality and thus in defects in the fibrous material web.

SUMMARY OF THE INVENTION

[0006] Therefore, the present invention provides a headbox of the type mentioned at the outset in which the lamella features an improved geometry at its lamella end such that the known disadvantages of the prior art, in particular instabilities in the flow conditions and tendencies to oscillation, are avoided.

[0007] According to the invention, a headbox of the type mentioned at the outset includes a lamella with a lamella length on its downstream lamella end having a slope on a side that faces one of the two nozzle walls and a structure on the opposite side.

[0008] This proposed geometry provides the advantage of the obtainability of stable flow conditions even with unsymmetrical flow channels and the best possible flow against the structured downstream lamella end with regard to avoiding turbulence.

[0009] From flow technology viewpoints it is advantageous if the slope features an angle of slope of about 1.5° to 6°, preferably about 2.5° to 5°, as, consequently, the percentage enlargement of the flow surface does not become too great, thus counteracting the production of separation eddies (turbulences).

[0010] The lamella end features preferably a height of about 0,3 ~~0.4~~ mm to 1,0 ~~0.6~~ mm, preferably about 0,4 mm to 0,6 mm ~~0.5 mm~~. This height is sufficient to give the lamella end the necessary rigidity for optimal operation of the headbox. K.F. 02-02-01 W.R. 02-02-01 H.L. 02-02-01

[0011] Furthermore, from material strength viewpoints, the lamella has a predominant lamella thickness of about 2 mm to 6 mm, preferably about 4 mm, since

these values have often proved worthwhile in practice in various areas of application.

[0012] In order to be able to influence the fiber orientation in the finished fibrous material web, the upper nozzle wall is provided with a preferably adjustable screen in the area of the exit opening, with the slope of the lamella being directed towards the screen.

[0013] From manufacturing and flow technology viewpoints, it is advantageous if the structure in the lamella features the form of grooves with rectangular and/or wedge shaped and/or parabolic and/or round form with constant and/or variable depth.

[0014] Taking into consideration the latest material developments in the field of polymers, the lamella can be made of at least one high-performance polymer. The high-performance polymer can be in particular a polyphenylene sulfone (PPSU), a polyethersulfone (PES), a polyetherimide (PEI) or a polysulfone (PSU).

[0015] From flow technology viewpoints, the lamella length, in accordance with the instant invention, has a value of at least about 80% of the nozzle length and a flow velocity of the fibrous suspension in the area of the downstream lamella end is in the range of more than about ~~5~~ 3 m/s.

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[0016] Furthermore, the lamella according to the invention can be formed in a headbox with sectioned consistency control (dilution water technology). This embodiment of the headbox provides the possibility of sectionally controlling the through-put, the consistency and, thus, the basis weight and the fiber orientation. Moreover, this control can be provided in the presence of optimal lamellae.

[0017] In order to take into account the present and future production requirements with regard to production volume and the like, the lamella can be mounted in a headbox designed for a stream velocity of more than about 1,500 m/s, preferably more than about 1,800 m/s.

[0018] The lamella can also be mounted in a headbox developed as a multi-layer headbox, with the lamella essentially featuring the aforementioned characteristics, being developed as an intermediate lamella.

[0019] It is contemplated that the instant invention can be used not only in the given combination, but also in other combinations or alone, without going beyond the scope of the invention.

[0020] The present invention is directed to a lamella of a headbox through which at least one fibrous suspension flows. The headbox has a machine-width headbox nozzle with a nozzle length and an exit opening, and the headbox nozzle is delimited by an upper nozzle wall and a lower nozzle wall. The lamella, which is structured and arranged to be mounted within the headbox nozzle, includes a lamella body having a downstream lamella end structured and arranged to be positioned downstream, relative to a suspension flow direction, of an opposite end of the lamella body, and the downstream lamella end includes a first surface, a portion coupled to an sloped relative to the first surface, and a second surface, located opposite the first surface, provided with a structure.

[0021] According to a feature of the present invention, the lamella can be structured and arranged to be mounted within the headbox nozzle supplying a suspension for forming paper, cardboard or tissue machine.

[0022] In accordance with another feature of the invention, the first surface may be structured and arranged to be positioned to face one of the nozzle walls.

[0023] The sloped portion can be oriented at an angle of between about 1.5° to 6° to the first surface. Further, the angle can be between about 2.5° to 5°. W.R. 02.02.01

[0024] Moreover, the downstream lamella end may have a height of between about 0.3 ~~0.4~~ mm and 1.0 ~~0.6 mm~~, and preferably about 0.4mm and 0.6 ~~0.5 mm~~. The height can be determined from a distance between an end of the sloped portion and the second surface. K.F. 02.02.01 H.L. 02-02-01

[0025] The lamella may have a predominant lamella thickness of between about 2 mm and 6 mm. Still further, the predominant thickness can be about 4 mm.

[0026] The lamella may be located within the headbox nozzle and the upper nozzle wall in the area of the exit opening can be coupled to an adjustable screen. The sloped portion may be positioned toward the adjustable screen.

[0027] The structure can include grooves having at least one of (A) at least one of essentially rectangular, wedge-shaped, parabolic, and essentially round structure, and (B) varying depth, and (C) varying spacing. H.L. 02-02-01 K.F. 02-02-01

[0028] The lamella may be composed of at least one high-performance polymer. W.R. 02.02-01 The high-performance polymer can include at least one of a polyphenylene sulfone (PPSU), a polyethersulfone (PES), a polyetherimide (PEI) or a polysulfone (PSU).

[0029] According to another feature of the present invention, the lamella may have a length that is at least about 80% of the nozzle length.

[0030] A flow velocity of the fibrous suspension in the area of the downstream lamella end can be within a range of more than about ~~5~~ 3 m/s. K.F 02-02-01

[0031] The lamella may be structured and arranged to be mounted in a headbox with sectioned consistency control. W.R. 02.02.01. H.L. 02-02-01

[0032] Moreover, the lamella may be structured and arranged to be mounted in a headbox designed for a stream velocity of more than about 1,500 m/s, and preferably the stream velocity can be more than about 1,800 m/s.

[0033] According to still another feature of the instant invention, the lamella can be structured and arranged to be mounted in a multi-layer headbox. Further, the lamella may be structured and arranged to be an intermediate lamella.

[0034] The present invention is directed to a headbox for supplying at least one fibrous suspension flows. The headbox includes a headbox nozzle having an exit opening, the headbox nozzle and the exit opening being delimited by an upper nozzle

wall and a lower nozzle wall, and a lamella mounted within the headbox nozzle having a downstream lamella end structured and arranged to be positioned downstream, relative to a suspension flow direction, of an opposite end of the lamella body. The downstream lamella end includes a first surface, a portion coupled to and sloped relative to the first surface, and a second surface, located opposite the first surface, provided with a structure.

[0035] In accordance with a feature of the invention, an adjustable screen can be coupled to the upper nozzle wall. The sloped portion may be positioned toward the adjustable screen.

[0036] According to another feature of the instant invention, the nozzle may have a nozzle length and the lamella can have a length that is at least about 80% of the nozzle length.

[0037] Further, a flow velocity of the fibrous suspension in the area of the downstream lamella end can be within a range of more than about ~~5~~ 3 m/s.

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[0038] Moreover, the headbox can be structured and arranged for sectioned consistency control.

[0039] The headbox can be designed for a stream velocity of more than about 1,500 m/s, and preferably the stream velocity can be more than about 1,800 m/s.

[0040] According to still another feature, the headbox may include in a multi-layer headbox. The lamella can be structured and arranged to be an intermediate lamella.

[0041] Moreover, the lamella may be fixedly mounted in the headbox nozzle.

[0042] Further still, the lamella can be pivotably mounted in the headbox nozzle.

[0043] The present invention is directed to a lamella for a headbox in a fibrous material web production machine. The lamella includes a lamella body having a first and second surface and a mountable end and a downstream end remote from the mountable end. The downstream end includes a sloped surface obliquely oriented

with respect to and coupled to the first surface and a structure provided at least one of in and on the second surface.

[0044] According to a feature of the instant invention, the sloped surface can be obliquely oriented relative to the first surface at an angle of between about 1.5° to 6° to the first surface. Further, the structure can include grooves having at least one of (A) at least one of essentially rectangular, wedge-shaped, parabolic, and essentially round structure, and (B) varying depth, and (C) varying spacing. H.C. 02-02-01 K.F. 02-02-01 W.R. 02-02-01

[0045] In accordance with still yet another feature of the present invention, the downstream lamella end can have a height, determined from a distance between an end of the sloped portion and the second surface, of between about ~~0.4~~ 0.3 mm and ~~0.6~~ 1.0 mm. K.F. 02-02-01 W.R. 02-02-01 H.C. 02-02-01

[0046] Other exemplary embodiments and advantages of the present invention may be ascertained by reviewing the present disclosure and the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0047] The present invention is further described in the detailed description which follows, in reference to the noted plurality of drawings by way of non-limiting examples of exemplary embodiments of the present invention, in which like reference numerals represent similar parts throughout the several views of the drawings, and wherein:

[0048] Figure 1 schematically illustrates a longitudinal section of a headbox with two lamellae according to the invention;

[0049] Figure 2 schematically illustrates an area view of a multi-layer headbox with a lamella according to the invention;

[0050] Figure 3a schematically illustrates a longitudinal section of a downstream lamella end of a lamella according to the invention; and

[0051] Figure 3b schematically illustrates plan views of structural end areas of

lamellae according to the invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0052] The particulars shown herein are by way of example and for purposes of illustrative discussion of the embodiments of the present invention only and are presented in the cause of providing what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the present invention. In this regard, no attempt is made to show structural details of the present invention in more detail than is necessary for the fundamental understanding of the present invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the present invention may be embodied in practice.

[0053] Figure 1 shows a headbox 1 in schematic longitudinal section. This headbox 1 comprises a feed device 2 for a fibrous suspension 3 in headbox 1. Feed device 2 is embodied or formed as a lateral distribution pipe 4. However, it is also contemplated that, in another embodiment, feed device 2 can also include a central distributor with feed hoses. Headbox 1 further comprises a machine-width device to produce microturbulences (i.e., a "turbulence producer") 5, upstream from which a machine-width antechamber 6 in flow direction S (arrow) of fibrous suspension 3 is located. As is generally known, turbulence producer 5 includes a plurality of turbulence pipes 5.2 of differing forms arranged in rows and columns next to and above one another. A machine-width headbox nozzle 7 arranged to distribute fibrous suspension 3 between two wires (i.e., lower wire 8.1 and upper wire 8.2) of a twin wire former (gap former) 9, which is not shown in detail, is located after turbulence producer 5 in flow direction S (arrow) of fibrous suspension 3. However, it is contemplated that, in a further embodiment, fibrous suspension 3 can also be distributed to only one wire of a fourdrinier wire former or a hybrid former. In

Figure 1, headbox nozzle 7 has a nozzle length L_D and is delimited on an initial or inlet side by turbulence producer 5, on an outer or outlet side by exit opening 7.1, laterally by an upper nozzle wall 13.1 and a lower nozzle wall 13.2, and on two sides by parts which are not shown. Two machine-width lamellae 10.1 and 10.2 are mounted in headbox nozzle 7 of headbox 1, with lower lamella 10.1 being flexibly attached and the upper lamella being rigidly attached to turbulence producer 5.

[0054] According to the invention, both lamellae 10.1 and 10.2 have a respective lamella length L_L, and, on their respective downstream lamella ends 11.1 and 11.2, sloped portions 12.11 and 12.12 are provided on the lamella surface arranged to face upper nozzle wall 13.2 and respective structures 12.21 and 12.22 are provided in or on the opposite surface, which faces lower nozzle wall 13.1. Respective lamella length L_L preferably has a value of at least about 80% of nozzle length L_D and flow velocities V_S (arrow) of fibrous suspensions 3, 3.1, and 3.2 in the area of both lamella ends 11.1 and 11.2 are in the range of more than about ~~5~~ 3 m/s. W.R. 02.02.01 K.F. H.L. 02-02-01 02-02-01

[0055] Furthermore, upper nozzle wall 13.2 is provided with a preferably adjustable screen 7.2 in the area of exit opening 7.1, and respective sloped portions 12.11 and 12.12 are directed toward screen 7.2.

[0056] Lamellae 10.1 and 10.2 are made of at least one high-performance polymer, which includes, e.g., a polyphenylene sulfone (PPSU), a polyethersulfone (PES), a polyetherimide (PEI) and/or a polysulfone (PSU).

[0057] In order to take into account the present and future production requirements regarding production volume and the like, lamellae 10.1 and 10.2 of headbox 1 are designed from hydraulic and flow technology viewpoints for a stream velocity V_{St} (arrow) of more than about 1,500 m/s, preferably of more than about 1,800 m/s.

[0058] The schematic perspective view of Figure 2 shows a headbox embodied or formed as a multi-layered headbox 1.1 having feeding devices 2, 2.1, 2.2, which are

only schematically shown, for introducing different fibrous stock suspensions 3, 3.1, 3.2. Nozzle 7 is limited in a known fashion by two flow guidance walls 13.1, 13.2 over the width of the machine. These walls are each connected to a central, stationary separation wall 14 by a known turbulence generator 5, 5.1. A separating lamella 16 is pivotally mounted on the distributing end of separating wall 14 by a joint 15. Alternatively, separating lamella 16 may also be mounted in a stationary manner relative to separating wall 14.

36A' ~~[0059]~~ According to the invention, the plurality of intermediate lamellae 16.1 are embodied or formed as lamellae 10, 10.1 according ~~to the invention~~.

[0060] According to the invention, multi-layered headbox 1.1 is embodied or formed as a headbox having a sectioned fibrous suspension density control (dilution water technology) as disclosed in German publication DE 40 19 593 A1, U.S. Patent No. 5,707,495, and U.S. Patent No. 5,885,420 of the Applicant, the disclosures of which are expressly incorporated by reference herein in their entireties. An initial fibrous stock suspension flow having a high consistency $Q_{H.1}$ travels via a crosswise distribution pipe 4 through a number of sectional feeding pipes 17_1 - 17n branching off therefrom to turbulence generator 5. Modified from Figure 2, a volume flow control may be provided in each of the sectional feeding pipes 17_1 - 17n. In order to embody a sectioned stock density control the second fibrous stock suspension flow, having a lower consistency Q_L, e.g., backwater-I, is guided via a crosswise distribution pipe 4.1 and sectional feeding pipes 18_1 - 18n into the sectional feeding pipes 17_1 - 17n. Each sectional feeding pipe 18_1 - 18n has a control valve 19_1 - 19n in order to feed a controlled sectional fibrous stock suspension flow Q_L to each of the corresponding merging or mixing points 20_1 - 20n in which it is merged or mixed with the sectional fibrous stock suspension flow $Q_{H.1}$. A third fibrous stock suspension flow having a medium or high consistency $Q_{H.2}$ arrives at the turbulence generator 5.1

via a crosswise distribution pipe 4.2 and via a number of sectional feeding pipes 21_1 - 21n branching off therefrom. Thus, in this embodiment of the multi-layered headbox 1.1, the possibility is created of allowing the sectional control of the throughput, the stock density, and thus the basis weight and the orientation of the fibers, in the presence of an optimal separation lamella 16.

[0061] Headbox 1 shown in Figure 1 may naturally also be embodied or formed as a headbox having sectioned stock density control (dilution water technology) according to the above-mentioned embodiments.

[0062] Figure 3a shows a schematic longitudinal section of downstream lamella end 11.1 of lamella 10.1 in accordance with the features of the present invention.

[0063] According to the invention, sloped portion 12.11 features an angle of slope α_S within a range of about 1.5° to 6°, and preferably between about 2.5° to 5°. Moreover, lamella end 11.1 features a height H from an end of the sloped portion to the bottom side 10.1 of between about 0.4 mm to 0.6 mm, and preferably about 0.5 mm. Lamella 10.1 has a predominant lamella thickness D of between about 2 to 6 mm, and preferably about 4 mm.

[0064] In another design, structured lamella end 11.1 may be embodied or formed with a grooved structure 22 that is essentially rectangular and/or wedge-shaped and/or parabolic and/or essentially round with constant and/or varying depths T and/or varying spacings P (Fig. 3b). H.L. 02-02-01

[0065] Figure 3b shows three schematic and exemplary plan views according to elevation arrow E depicted in Figure 3a on structured lamella ends 11.1 of lamellae 10.1 according to the invention. W.R. 02.02.01 K.F. 02-02-01

[0066] It is clearly shown that structured lamella ends 11.1 of lamellae 10.1 according to the invention can feature a plurality of grooves 22 with rectangular (A) and/or wedge-shaped (B) and/or parabolic (C) and/or round form with constant and/or varying depth and/or varying spacing. H.L. 02-02-01 W.R. 02.02.01 K.F. 02-02-01

[0067] Further combinations regarding the design of the structured end areas are known to the applicant from German published patent application DE 43 29 810 A1 and U.S. Patent No. 5,639,352, the disclosures of which are expressly incorporated by reference herein in their entireties.

[0068] In summary, it should be noted that the invention provides a headbox of the type mentioned at the outset, the lamella of which features an improved geometry at its lamella end, so that the known disadvantages of the prior art are avoided, in particular instabilities in the flow conditions and oscillation tendencies.

[0069] It is noted that the foregoing examples have been provided merely for the purpose of explanation and are in no way to be construed as limiting of the present invention. While the present invention has been described with reference to an exemplary embodiment, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitation. Changes may be made, within the purview of the appended claims, as presently stated and as amended, without departing from the scope and spirit of the present invention in its aspects. Although the present invention has been described herein with reference to particular means, materials and embodiments, the present invention is not intended to be limited to the particulars disclosed herein; rather, the present invention extends to all functionally equivalent structures, methods and uses, such as are within the scope of the appended claims.

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Reference Numbers

1	Headbox
1.1	Multi-layer headbox
2, 2.1, 2.2	Feed device
3, 3.1, 3.2	Fibrous suspension
4, 4.1, 4.2	Lateral distribution pipe
5, 5.1	Turbulence producer
5.2	Turbulence pipe
6	Antechamber
7	Headbox nozzle
7.1	Exit opening
7.2	Screen
8.1	Lower wire
8.2	Upper wire
9	Twin wire former (gap former)
10.1, 10.2	Lamella
11.1, 11.2	Lamella end
12.11, 12.12	Slope
12.21, 12.22	Structure
13.2	Lower nozzle wall
13.1	Upper nozzle wall
14	Dividing wall
15	Hinge
16	Dividing lamella
16.1	Intermediate lamella

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17...17.n	Sectional feed line
18...18.n	Sectional feed line
19...19.n	Control valve
20...20.n	Mixing location
21...21.n	Sectional feed line
22	Groove
A, B, C	Plan view
D	Lamella thickness
E	Elevation arrow
H	Height
L_D	Nozzle length
L_L	Lamella length Spacing
$Q_{H.1}$	First fibrous suspension flow with high consistency
$Q_{H.2}$	Third fibrous suspension flow with medium/high consistency
Q_L	Second fibrous suspension flow with low consistency
S	Flow direction (arrow)
T	Depth
V_S	Flow velocity (arrow)
V_{st}	Stream velocity (arrow)
α_S	Angle of slope

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